REMARKS

In view of the above amendments and following remarks, reconsideration of the objections and rejections contained in the Office Action of February 14, 2001 is respectfully requested.

FORMAL MATTERS

Amendments to Specification

A few minor editorial changes have been made to the specification to generally place the present application into better form.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current Amendment. The attached page is captioned "**Version With Markings to Show Changes Made**".

Drawing Objections

The Examiner objected to the drawings under 37 CFR 1.83(a) as not showing "bump electrodes and the larger particles". While it is noted that this phraseology, quoted by the Examiner, is not employed in any of the claims, Applicant nevertheless understands the objection to be, from the other objections raised by the Examiner, to the language of claim 52. Thus, claim 52 recites "each of said particles has a size greater than a thickness of a passivation film . . ." This is dependent from claims that reference the bumps. However, the embodiment of Figs. 12 that discusses the particles having a size greater than the thickness of the passivation film does not employ the bumps. Thus the reason for the Examiner's objection, according to Applicant's understanding.

Accordingly, claim 52 has now been redrafted into independent form and so as to remove reference to the bumps. This is believed to fully address the Examiner's objections.

Rejections under 35 U.S.C. §101

The Examiner rejected claims 58-76 as being allegedly drawn to non-statutory subject matter. This rejection by the Examiner is most strenuously and adamantly traversed as being clearly incorrect as a matter of law.

Thus, the claims are clearly directed to an apparatus, which constitutes a new and useful machine. Thus, the claims clearly specify material which falls within the ambit of 35 U.S.C. §101. Thus the claimed subject matter is clearly statutory.

The Examiner alleges that the claims overlap statutory classes of invention. This is clearly incorrect, as it can be seen from the preamble of each claim that each claim is clearly directed to an apparatus. The claims do not purport to be directed to an apparatus and a method, but only an apparatus, noting for example claim 58, which includes such devices as a positional alignment device, a heating device and a pressing device. The recitation of the function of each of these respective devices does not mitigate the fact that these are apparatus limitations. There is nothing wrong with reciting the purpose in operation of a component of an apparatus within a claim. Indeed, such manner of claim drafting is notorious.

The reference to MPEP s. 2173.05(p)II, and the reference to *Ex Parte Lyell*, are not relevant. In the case of *Ex Parte Lyell*, the preamble was directed to both the apparatus and the method. Further, the claim itself recited a series of components of the apparatus, and then purported to recite a series of steps. This is clearly a different situation than the present claims, which are clearly directed to the apparatus per se, simply discussing the manner of use with respect to the components of the device, and how such components are used. Accordingly, withdrawal of the claim rejections based on 35 U.S.C. §101 is requested.

The objection to the specification should clearly be overcome by the above cancellation of claim 52.

Claim Rejections under 35 U.S.C. §112

The rejection of claim 52 should clearly be overcome by the above.

Similarly, rejection of claim 52 under 35 U.S.C. §112, second paragraph should clearly be overcome by the above.

Regarding claims 58-76, the recitation of the operability of the various components and devices of the apparatus do not render the claims indefinite. See the above discussion.

THE PRESENT INVENTION PATENTABLY DISTINGUISHES OVER MURAKAMI

The Present Invention as Distinguished from Murakami

The Examiner rejected claims 39-42, 45, 48, 54, 58-76 as being anticipated by Murakami. Furthermore, claim 43 was rejected as being unpatentable over Murakami in view of Tsukagoshi et al. Claim 44, 46, 47, 56 and 57 were rejected as being unpatentable over Murakami in view of Tang et al. Further, claims 49 and 53 were rejected as being unpatentable over Murakami in view of Tang et al. and Matsumoto et al. Claim 50 was rejected over Murakami by itself. Claim 51 was rejected as being unpatentable over Murakami and Viza et al. Claim 52 was rejected as being unpatentable over Murakami, Viza and Tsukagoshi et al., and in further view of Matsubara et al. However, it is respectfully submitted that the present invention clearly patentably distinguishes over each of the above references.

According to the present invention, the bonding is executed by hardening with heat the thermosetting resin interposed between the electronic component and the circuit while simultaneously performing leveling of the bumps and correction of any warping of the board by pressurizing the electronic component against the circuit board with the pressure force of at least 20 gf per bump, thereby bonding the electronic component and the circuit board together for electrical connection between both the electrodes thereof.

Murakami merely discloses that "[a]fter deforming the bump electrode by a predetermined amount (that is, deformed such that a contact portion with said mounting pad is enlarged from a point to a plane), the sealing resin is hardened and the semiconductor device is mounted on a substrate" (SEE ABSTRACT). Also note column 3, lines30 - 38: "the semiconductor device 104 is pressed to the circuit substrate 101, such that the tail 106 of the

bump electrode 107 is plastically deformed and in press contact with the bottom 110 of the mounting pad 103 as shown in Fig. 2c. Then, the sealing resin 109 is hardened by heating in a state in which the resin 109 is bonded also to the surface of the semiconductor device 104 on which the bump electrode 107 is disposed" (Emphasis added).

In Murakami, since the heated resin is hardened and heat-shrunken after the bumps are deformed, voids may be easily generated due to the heat shrinkage, not due to the volume of the pushed-out resin pushed-out from the gap between the electronic component and the circuit board.

Contrarily, when the bonding is executed by hardening with the heat the thermosetting resin interposed between the electronic component and the circuit board while simultaneously performing leveling of the bumps and correction of any warping of the board as in the present invention, the hardening can be started at the instant of pressurizing. The pressurizing is continued during the hardening, so that the unnecessary resin is pushed out from the gap between the electronic component and the board due to the softening of the resin. Even if a void is generated in the gap due to head shrinkage, the resin is pressurized to fill the void with the softened resin during hardening and heat shrinkage, resulting in the impossibility of generated voids and accomplishing bonding with high reliability.

Furthermore, in Murakami, since hardening is performed after pressurizing, the process time is the sum of process times of hardening and pressurizing.

Contrarily, in the present invention, since hardening and pressurizing (bump leveling) are simultaneously performed, the process time is shorter than that of Murakami. It would be clearly understood that if pressurizing is performed during the same process time as in Murakami, the total heat applied to the resin during the entire process in the present invention becomes larger than that of Murakami. In other words, this means that since the time for reaching the target total heat is shorter than Murakami, the processing time becomes shorter than Murakami.

With the present invention, the circuit board is provided by a glass cloth base epoxy copper clad laminate board (glass epoxy board), a glass cloth base polyimide resin copper clad

laminate board, or the like. These boards have warp and undulation due to thermal hysteresis, etc.

In Murakami, since hardening is performed after pressurizing, the bonding can not be stably performed due to the warping of the board. That is, even though the warping of the board may be corrected during pressurizing, the correction of the warping of the board is not fixed or held with anything in Murakami. As such, any correction is not sufficiently held during the hardening with the pressure removed. Thus, unstable bonding might be performed, including the warping of the bond.

Also note the discussions in Murakami, for example at column 5, line 66, to column 6, line 3: "Further, the pressing force exerting from the bump electrode 107 to the mounting pad 103 is dispersed in the inner layer circuit 102 disposed below the mounting pad 103. Accordingly deformation of the mounting pad 103 can be reduced." This portion of Murakami is also suggestive of correction of the warping perhaps not even taking place in Murakami. At least, it seems clear that Murakami is more concerned with reducing influence of the pressing force of the bump electrodes.

Contrarily, in the present invention, since hardening and pressurizing (bump leveling) are simultaneously performed, stable bonding can be surely performed. In addition, since the heat is started to be applied to the board at the beginning of the bonding process, in a case where the board is formed of organic material such as epoxy resin etc., the epoxy resin etc. of the board becomes softer to easily perform the correction of the warping. There is no disclosure or suggestion of such from Murakami.

Discussion of Specific Claim Distinctions

There are now three independent claims in the present application. The above discussion of the differences between Murakami and the present invention is most relevant to independent claim 39. This claim specifically requires that hardending with heat of the thermosetting resin take place while achieving pressing between the electronic component and the circuit board. It further specifically requires that hardening, levelling of the bumps and correction of any warping

of the circuit board take place at approximately the same time. As discussed above, such is clearly not discussed or suggested in Murakami.

The Examiner's position appears to be that column 5, line 47 of Murakami requires pressing while heating, and therefore the rest of the limitations flow as a natural consequence. However, such an interpretation would contradict other parts of Murakami discussed above. Further, this part simply says "pressed under heating", but does not specifically require or suggest that they occur at approximately the same time; more specifically, it does not require or suggest that hardening by heating take place while pressing as required by claim 39. Because the entirety of Murakami is not suggestive of the above discussed features, it is respectfully submitted that the present invention as set forth in claim 39 clearly patentably distinguishes over Murakami.

Claim 58 was also rejected by the Examiner as being anticipated by Murakami. This rejection is clearly improper. The Examiner has manifestly failed to establish a *prima facie* case of anticipation of claim 58 based upon 35 USC s. 102. Thus, this kind of rejection requires that each and every element of the claim be found within the reference. In fact, none of the elements of claim 58 are found within Murakami.

Claim 58 requires, *inter alia*, a positional alignment device, a heating device, and a pressing device. None of these elements is found within Murakami. In reviewing Murakami, it is true that the reference discusses the fact that the device 105 is aligned, and pressing and heating of the device 105. But Murakami never discusses any device for carrying out any of these functions. There is never even any suggestion of the existence of such devices. Thus there is never any disclosure of an alignment device, a heating device, or a pressing device per se, much less as recited in claim 58. For this reason, withdrawal of the rejection of claim 58, as well as all of its dependent claims, is submitted to be mandatory, and is requested.

Claim 52 was rejected by the Examiner as being obvious from Murakami, Viza, Tsukagoshi and Matsubara. However, it is noted that the claim similarly requires hardening with heat while pressing to correct warping and bond the electronic component. This is not disclosed

or suggested by Murakami as noted above. Further, there is no proper suggestion of the combination proposed by the Examiner from these references. For example, to replace the bumps of Murakami with the particles of Tsukagoshi would involve removing an aspect of Murakami fundamental to it; such is not obvious.

Nor is there any suggestion that the particles have a size greater than the thickness of the passivation film but smaller than the thickness of the electrode. As such, it is clear that claim 52 patentably distinguishes over the prior art cited by the Examiner.

There are a number of additional distinctions set forth in the various dependent claims. However, in view of the above clear distinctions between the independent claims and the references, reliance upon and discussion of such distinctions does not appear to be necessary at this time.

CONCLUSION

In view of the above it is respectfully submitted to be clear that the present invention is not anticipated by Murakami nor rendered obvious by any of the combinations or references proposed by the Examiner. Indication of such is respectfully requested.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is invited and respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,
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August 14, 2001

Version with Markings to Show Changes Made

IN THE SPECIFICATION

Please amend the specification as follows:

Please replace the paragraph beginning at page 29, line 7, to page 30, line 2, with the following rewritten paragraph:

In this case, the circuit board 4 is provided by a glass cloth base epoxy copper clad laminate board (glass epoxy board), a glass cloth base polyimide resin copper clad laminate board, or the like. These boards 4 have warp and undulation due to thermal [histeresis] hysteresis, cutting, and processing, meaning that their surfaces are not completely flat surfaces. Therefore, as shown in Figs. 4A and 4B, by using the boding tool 8 and a stage 9 of which the parallelism is controlled so as to be adjusted to, for example, about 5 μm or less, heat and load are locally applied to the circuit board 4 through the IC chip 1 from the side of the bonding tool 8 toward the side of the stage 9, so that the warp of the portion of the circuit board 4 receiving the heat and load is corrected. The IC chip 1 is warped with a concave portion located around the center of its active surface. By pressurizing this with a heavy load of not smaller than 20 gf in the bonding stage, the warp and undulation of both the board 4 and the IC chip 1 can be corrected. The warp of the IC chip 1 is generated by an internal stress occurring when the IC chip 1 is formed, that is, when a thin film is formed on Si.

Please replace the paragraph beginning at page 33, line 18, to page 34, line 4, with the following rewritten paragraph:

In this case, the circuit board 4 is provided by a multilayer ceramic board, a glass cloth base epoxy copper clad laminate board (glass epoxy board), an aramid unwoven fabric board, a glass cloth base polyimide resin copper clad laminate board, FPC (Flexible printed circuit board), or the like. These boards 4 have warp and undulation due to thermal [histeresis] hysteresis, cutting, and processing, meaning that their surfaces are not the completely flat surfaces. Therefore, by locally applying heat and load to the circuit board 4 through the IC chip 1, the warp of the portion that belongs to the circuit board 4 and has received the heat and load is corrected.

Version with Markings to Show Changes Made

IN THE CLAIMS

Please amend the claims as follows:

50. (Amended) A method as claimed in claim 39, wherein, prior to said aligning, said thermosetting resin, in the form of a solid thermosetting resin sheet having on at least one surface thereof a flux layer, is applied to said circuit board, and said bonding is executed by said hardening said sheet while simultaneously performing said correcting by pressing said electronic component toward said circuit board by a heated [headed] head, thereby causing said bumps to break through said sheet and causing said bumps to bond to said electrodes of said circuit board due to adhesion of a flux component of said flux layer to said bumps.

52. (Amended) A method of mounting an electronic component, said method comprising:

aligning in position electrodes of said electronic component with electrodes of a circuit board, with interposition between said electronic component and said circuit board of insulative thermosetting resin;

hardening with heat said thermosetting resin interposed between said electronic component and said circuit board, while achieving mutual pressing between said electronic component and said circuit board, thereby correcting any warping of said circuit board, and thereby bonding said electronic component and said circuit board together to achieve electrical connection between said mutual electrodes thereof;

wherein, prior to said aligning, said thermosetting resin, in the form of a solid thermosetting resin sheet having holes formed at positions corresponding either to said bumps or to said electrodes of said circuit board and extending in a direction of extension of said bumps, with particles being embedded and electrically continuous in said holes, said particles comprising resin balls having surfaces plated with gold, nickel particles, conductive particles made of silver, silver-palladium or gold, conductive paste, or gold balls, is applied to said electrodes of said circuit board by positional alignment, and said bonding is executed by said hardening said sheet by application of heat thereto while conducting said pressing by forcing said electronic component toward said circuit board; and

[A method as claimed in claim 51,] wherein each of said particles has a size greater than a

thickness of a passivation film to be coated on at least said electrodes of said electronic component and smaller than a thickness of one of said electrodes of said circuit board, and said bonding further is executed by applying ultrasonic vibrations to said electronic component.